Relation of Nutrition to Health in Aging Persons

A Four-Year Follow-up of a Study in San Mateo County

HAROLD D. CHOPE, M.D., San Mateo

• A follow-up study of 577 San Mateo County residents over 50 years of age who were originally studied in 1948 was carried out. Three hundred fifty still were available for reevaluation. Mortality studies showed a higher death rate in males than in females, in persons of the lower economic levels, and in those with systolic blood pressure of more than 180 mm. of mercury. Correlations between factors studied and morbidity were not conclusive, but suggested relationships between low economic status and digestive system disease; low hemoglobin and high incidence of respiratory disease; high caloric intake and digestive system disease; low thiamine intake and nervous system disease; low ascorbic acid intake and diseases of the circulatory and digestive systems.

DURING THE SUMMER and fall of 1948 and the early part of 1949, a study of the nutritional status of 577 citizens, over 50 years of age, in San Mateo County was conducted with the cooperation of the U. S. Bureau of Human Nutrition and Home Economics, the U. S. Public Health Service, the Department of Home Economics of the College of Agriculture of the University of California, the California State Health Department and the Department of Public Health and Welfare of San Mateo County. A preliminary report of this study was published in February 1951.[1]

Subsequent papers on the nutritional data obtained from the study have been published by Gillum and Morgan[2] and co-workers at the University of California.

The 1948-49 survey in San Mateo County was probably the largest cross-section study of the nutritional status of aged people made to that date. It was the consensus of the persons involved in the study that "longitudinal studies," or repeated examinations of the same subjects, might offer more useful information than the continued observance of new subjects. Funds became available in the spring of 1952 and it was decided to re-survey as many of the original subjects as possible during the summer and fall of 1952.

The same general fields (but somewhat simplified) were included in the second survey. Several items included in the physical examination, found to be of no significance in the original study, were deleted in the second study. It was the opinion of the nutrition experts who worked on the project that as much data could be obtained from the subject's recollection of what he had eaten on a specific day as from a seven-day recorded diet. Therefore, this method was adopted for the 1952 study. In the original study, 14 blood chemical determinations, roentgen study of the chest and a bone-density determination were carried out. In the current study, this bank of tests was reduced to six—determination of the content of hemoglobin, ascorbic acid, vitamin A, carotene, cholesterol and sugar in the blood. The chest x-ray and the bone density determination were not repeated.*

After intensive follow-up procedures, it was determined that there was a potential of 350 of the original subjects examined in 1948 available for interview and examination in 1952. The remaining 225 of the original 577 were unavailable for the following reasons:

Dead (as of September 1, 1952)	49
Not interested, refused	55
Too ill to cooperate	13
Moved out of county	72
Out of county temporarily	15
Uncontacted, all leads exhausted	21
	225

Of the 350 possible candidates for reexamination, 306 actually completed the full schedule including the physical examination, the nutritional history and the laboratory work.

Upon review of local and state records notices of the death of 49 of the original 577 participants were found. Analysis of data concerning the persons who died is given in Tables 1 through 6.

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*Mr. Richard Handschin, a fourth-year medical student, and the public health nurses of the San Mateo County Health Department were responsible for the follow-up. Dr. Warren Hall did the clinical evaluations, and two nutritionists and a laboratory technician, employed by the University of California, did the diet evaluations and the laboratory determinations.

Although the numbers are small, there is a statistically significant difference between the percentage of deaths in the males and in the females and, as would be expected, in the older age groups as compared with the younger age groups (Table 1).

Age-specific death rates by six general classifications of cause of deaths were prepared (Table 2). By applying the age-specific death rates for the county as a whole to the study group for the four-year period, it was found that the number of deaths in the study group was somewhat less than the expected number of deaths in the group, if the experience for the age groups of the whole county had applied.

The original subjects, when selected in 1948, were all healthy—at least they had no symptoms and were not under medical care. It would be reasonable to expect that in such a group the number of deaths would be less (it was 49) than in the general population (it would have been 73 in the study group if the total county experience had been applied).

The causes of deaths in the 49 subjects are shown in Table 3.

Deaths by economic status were analyzed for the study group. The death rate in the low economic groups was nearly four times that in the middle economic group—22.6 per cent as compared with 5.2 per cent. The percentage of deaths in the high economic group, in which there were only 24 subjects, was very close to the average for the total group—8.3 per cent.

The original 577 subjects were all well at the time of the first examination and none had been under the care of a physician for a period of at least three months. However, 243 (or 42.1 per cent) of the total group were referred to private physicians because of abnormalities noted in the physical examination or in laboratory studies. The list of reasons for referral was detailed in the previous paper. At the end of four years, only 17 (or 5.1 per cent) of those not needing medical attention had died, while 32 (13.2 per cent) of those referred to physicians had died.

There appeared to be a relationship between systolic blood pressure and mortality, as shown in Table 4. The death rate of both males and females with diastolic blood pressure over 100 mm. of mercury was somewhat higher than among those with diastolic pressure below that level, although the correlation was not as pronounced as it was in relationship to systolic pressure.

No striking relationships between the death rate in the group and the following factors were noted: Hemoglobin content of the blood, blood glucose, blood creatinine, caloric intake, protein intake, fat intake, carbohydrate intake, calcium intake, iron intake, or cholesterol intake. However, there appeared to be some relationship between mortality and the cholesterol content of the blood (Table 5).

This finding of a higher percentage of deaths in the group of subjects with low or normal blood cholesterol might seem contrary to the general belief that blood cholesterol bears a relationship to arteriosclerosis and myocardial infarction. However, Gofman and associates at the Donner Laboratory have expressed belief that the total blood cholesterol bears little relationship to the S_f 10-20 class of lipoprotein which they associate with arteriosclerosis. Unfortunately, the ultracentrifuge technique was not applied

TABLE 1.—*Deaths by age and sex—September 1, 1948 to September 1, 1952; 577 subjects, San Mateo County*

Age group	No. in group	Deaths No.	Deaths Pct.	Deaths, males No.	Deaths, males Pct.	Deaths, females No.	Deaths, females Pct.
50-59	192	3	1.6	3	12.9	....	0.0
60-69	214	14	6.5	10	14.4	4	3.5
70 and over	170	32	18.8	23	25.4	9	11.4
Not stated	1	....	.....	....	.....	0	0.0
Total	577	49	8.5	36	12.9	13	4.4

TABLE 2.—*Deaths in study group in four years by age groups compared with expected deaths using total county experience*

Age groups	No. in group	Deaths No.	Deaths Pct.	—Total county experience— Age specific death rate	Predicted deaths in study group No.	Predicted deaths in study group Pct.
50-59	192	3	1.6	11.51	8	4.2
60-69	214	14	6.5	23.61	19	8.8
70 and over	170	32	18.8	77.90	46	27.0
Not stated	1	0	.....	.....	....	.....
Total	577	49	8.5	.....	73	12.6

TABLE 3.—*Causes of deaths analyzed by groups and by sex for 577 subjects—1948 to 1952, San Mateo County*

	Cause of death	Male	Female	Total	Percent from each cause	Total deaths from same cause in population over 50 years of age, percent
(400-468*)	Heart and circulatory	20	5	25	51.0	56.7
(330-398)	Central nervous system and circulatory	3	5	8	16.3	11.1
(140-205)	Neoplasms	6	1	7	14.3	15.5
(470-521)	Respiratory pneumonia	2	1	3	6.1	2.0
(812-)	Accidents	0	1	1	2.0	2.8
	All other causes	5	0	5	10.3	11.9
		36	13	49	100.0	100.0

*Numbers in parentheses indicate Sixth Revision International Statistical Classification numbers.

TABLE 4.—*Deaths in relation to systolic blood pressure and sex; 577 subjects—San Mateo County*

Systolic pressure mm. of mercury	Total group			Males			Females		
	No.	Deaths	Pct.	No.	Deaths	Pct.	No.	Deaths	Pct.
Less than 140	115	5	4.3	67	4	6.0	48	1	2.1
140-179	300	21	7.0	148	18	12.2	152	3	2.0
180 and over	161	23	14.3	65	14	21.5	96	9	9.4
Not stated	1	....	.....	.....	....	.....	1	....	....
Total	577	49	8.5	280	36	12.9	297	13	4.4

TABLE 5.—*Relation of death rate to cholesterol content of blood*

Total cholesterol (mgm. per 100 ml. of blood)	No. of persons	Died	Percent
Less than 220	145	22	15.2
220-279	276	19	6.9
280 and over	148	6	4.1
Not determined	8	2	.....

TABLE 6.—*Relation of death rate to intake of vitamin factors*

	Subjects	Deaths	Mortality	Pct.
Vitamin A (international units)				
Less than 5,000	158	22	13.9	
5,000-7,999	160	11	6.9	
8,000 and over	211	9	4.3	5.4
Not determined	48	7	.....	
Niacin (mg.)				
Less than 10	154	16	10.4	
10-13	196	16	8.2	
14 and over	179	10	5.6	6.9
Not determined	48	7	.....	
Ascorbic acid (mg.)				
Less than 50	130	24	18.5	
50-109	251	9	3.6	
110 and over	148	9	6.1	4.5
Not determined	48	7	.....	
	577	49		

to the specimens of blood from subjects included in the San Mateo County study.

There seemed to be relationships between mortality and the intake of vitamin A, niacin and ascorbic acid. The death rate was greater among subjects with a low intake of these vitamin factors than it was among subjects with a higher intake (Table 6).

No definite conclusions should be drawn from the data. The numbers involved in the calculations were small—577 subjects and 49 deaths. However, the data on deaths after four years did suggest the following:

1. In persons over age 50, the death rate in males is higher than in females.

2. That those in the low economic levels have a shorter expectancy after age 50 than those in the middle or upper economic levels.

3. That patients, particularly males, over 50 years of age with systolic pressures over 180 mm. of mercury, do not have a very favorable prognosis.

4. That low vitamin intake, particularly vitamin A, niacin and ascorbic acid, appear to predispose to a high mortality.

MORBIDITY

As was previously mentioned, 306 persons from the original study were returned for the second evaluation, physical, dietary and laboratory. Of the 306, there were 78 (25.5 per cent) who reported no illness whatever during the four-year period. Two hundred and twenty-eight (74.5 per cent) reported one or more illnesses during the period (average 1.5 illnesses per person). Seventy-two per cent of the males and 77 per cent of the females reported illness. The smallest percentage of illness was in the 60 to 69 age group (71.2 per cent). It was 75.4 per cent in the 50 to 59 age group and 78.1 per cent in the 70 and over group.

The 228 persons reporting illness during the four-year period reported 341 illnesses. Using the Sixth Revision of the International Statistical Classification, these 341 illnesses were classified into five general groups and a sixth group of "all other causes." These five groups (with the parenthetical numbers assigned by the International Classification) were:

Nervous system and sense organs (330-398, 780-781, 790-791).

Circulatory system (400-468, 782).

Respiratory system (470-527, 783).

Digestive system (530-587, 784, 785).

Musculoskeletal system (690-748).

All other (001-326, 590-637, 786-789, 792-795).

The distribution of these 341 reported and confirmed illnesses into these five groups was as follows: Nervous system, 10.8 per cent; circulatory system, 18.8 per cent; respiratory system, 18.8 per cent; digestive system, 14.6 per cent; musculoskeletal, 13.8 per cent; all other, 23.2 per cent. The same percentage distribution was then calculated for the various sub-classifications. Only the apparently significant differences will be reported here. In the age group 50 to 59, respiratory disease accounted for the highest percentage of illness, while in the group 60 to 69 years of age, circulatory disease was high; and in the group over 70 years of age, nervous system disease (probably cerebral hemorrhage) was nearly twice as common as in the groups under 70. Digestive system and musculoskeletal disease accounted for a very few illnesses in the age group over 70.

The incidence of respiratory disease was higher in males than in females, but with regard to the other four disease groups there was remarkably little difference between the sexes.

Disease of the circulatory system was of highest incidence among persons with systolic pressure over 180 mm. of mercury and diastolic pressure over 100 mm., and respiratory tract and digestive tract diseases were highest in those with low (140 mm. or less) systolic blood pressure.

Persons in the low economic group had a considerably lower incidence of nervous, circulatory, respiratory or musculoskeletal disease but a much higher incidence of digestive system disease than did subjects in the middle or upper economic groups.

Among subjects not referred to physicians in the original study there was more nervous system and respiratory disease than there was among those who had been referred, but the incidence of circulatory disease was highest among those who had been referred.

In subjects with low hemoglobin (less than 13 gm. per 100 cc.) there was high incidence of respiratory disease. Among persons with high hemoglobin content (15 gm. per 100 cc. and over), the incidence of digestive system disease was relatively high and of musculoskeletal disease very low.

The higher the caloric intake, the lower the incidence of circulatory disease and the higher the incidence of digestive tract disease. Also, among persons with a high caloric intake (2,600 calories or more daily) the incidence of nervous system disease was very low.

The amount of protein intake seemed to have little effect on illness associated with the nervous system or the circulatory system, but among subjects whose protein intake was in the middle range (60 to 79 gm. a day) the incidence of respiratory disease was high and of digestive and musculoskeletal system disease low.

In subjects with low intake of vitamin A (less than 5,000 international units) the incidence of nervous system, circulatory system and respiratory system disease was high and the incidence of digestive and musculoskeletal system disease was low. Those with a high vitamin A intake (8,000 international units and over) had a low incidence of nervous system disease and circulatory disease, had about the group average of respiratory and digestive system disease, but a high incidence of musculoskeletal system illness.

Low thiamine intake (less than 0.80 mg. a day) seemed to be associated with nervous system disease and circulatory disease; the higher the intake of thiamine, the lower the incidence of disease of these two systems.

Diseases of the circulatory system and the digestive system were associated with low intake of ascorbic acid (less than 50 mg. per day). Among persons with a high intake of ascorbic acid (110 mg. and over) there was a low incidence of nervous system and circulatory system disease.

Two sets of data were available regarding cholesterol—the calculated cholesterol intake and the cholesterol content in the blood. Those with low content of cholesterol in the blood (less than 220 mg. per 100 cc.) showed a high incidence of musculoskeletal disease, but those with low intake of cholesterol (less than 450 mg. a day) showed no remarkable deviation from the group average incidence of musculoskeletal disease. Subjects with a high content of cholesterol in the blood had low incidence of musculoskeletal disease while those with a high dietary intake of cholesterol had a high incidence of musculoskeletal disease. Among subjects with a high level of cholesterol in the blood the incidence of circulatory disease was high, but those with a high cholesterol intake (760 mg. a day or more) had less circulatory disease than the average incidence for the whole group.

No conclusions should be drawn from these stated relationships except that there is an urgent need to carry on further intensive research into the effect of nutrition on the health status of persons over 50 years of age.

225 Thirty-seventh Avenue, San Mateo.

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